NITE-TIMES NEWS

CHICAGO AREA TIMEX USERS GROUP

Chicago Area Timex Users Group — Downers Grove, Illinois
Volume 7, Number 4 — July/August 1993

MEMORY MAP

ROUTINES — *ADDRESS*

C.A.T.U.G. CLUB OFFICERS

Here is the list of 1993 club officers and how to contact them. The club has two strong SIGs, SPECTRUM/TS2068 and QL. If you have questions about either of these fine machines or even the ZX81/TS1000/TS1500 call one of the officers. C=312, S=708.

POSITION	NAME	PHONE	PRIMARY FUNCTION
President	Nazir Pashtoon	S439-1679	The buck stops here...
Vice-President	Steve Cooper	S968-3553	Meeting Planning, etc.
Secretary	Jim Brezina	S832-1782	Records and Reporting
Treasurer	Frank Mills	S544-1918	Dues and Purchasing
Editor	Bob Swoger	S576-8068	Newsletter, BBS, etc.

Nite-Times Information

The Nite-Times News is the newsletter of the Chicago Area Timex Users Group. For an annual fee of $12.00 you can become a CATUG member and receive six newsletters each year. Write your check payable to:

FRANK MILLS
417 S 47th AVE
BELLWOOD IL 60104

The Chicago Area Timex Users Group is pleased to exchange newsletters with other Timex and Sinclair supporting user groups at no charge. Send all newsletter requests to:

CATUG EDITOR BOB SWOGER
613 PARKSIDE CIRCLE
STREAMWOOD IL 60107-1647

If you desire to reprint any articles that appear here, please provide credit to the author and this newsletter.

We encourage your user group to copy this newsletter and distribute it at your regular meetings to your members free of any charge as we believe that this will encourage better meeting attendance. If you are a user group that feels as we do, please let us know in your newsletter so that we might do this for our members and keep our attendance up.

Articles originating from our group may be downloaded from our BBS and reprinted.

CONTRIBUTORS TO THIS ISSUE

Cedric Bastiaans
Jim Brezina
Frank Mills
Larry Sauter
Bob Swoger, K9WVY

CLUB MEETINGS

The Chicago Area Timex Users Group meets on the THIRD Saturday of each month at the home of our meeting coordinator Steve Cooper in Downers Grove, Illinois from 1:00 to 5:00 PM. Steve's home is lovingly called the CLUB HOUSE and is located at 1300 Maple Street in Downers Grove just 2 blocks southwest of the Downers Grove Public Library. Steve should always be contacted evenings at 708/968-3553 to confirm the meeting schedule.

TREA$URY NOTE$

The balance as of Aug. 30, 1993 is $351.73 Our current paid membership stands at 19.

Frank Mills, Treasurer
Chicago Area Timex Users Group

SECRETARY'S NOTEPAD

July 17, 1993

Meeting called to order at 2:00 P.M. Those present were Frank Mills, Nazir Pashtoon, Bob Swoger, Larry Sauter, Abed Kahale and Steve Cooper.

Bob mentioned that he bought a number of disk drives with cases and power supplies at bargain prices from the 2nd Last Annual CoCoFest. He then talked about the ISTUG picnic he attended in Peru Indiana. He apologized for forgetting to bring the video he made while there.

Meeting adjourned at 2:52.

August 21, 1993

Present were President Nazir Pashtoon, John Pagano, Steve Cooper, Abed Kahale, Larry Sauter, and Bob Swoger.

The meeting opened with a showing, on Steve Cooper's theater sized TV screen, of the video made at the ISTUG Picnic showing the Z88 acquired by Paul Holmgren.

Paul went into some detail of the high points of this latest version of the Z88 which included more available RAM and a new Version 4._ operating system which gave him over 100K of free space and new packaging never before seen by Paul. The EPROM rather than tape/floppy/hard drive approach to storage was explained. This showed us why there has never been crash/loss of data reports from this machine, EPROMs just don't do that. After over four hours on the picnic table exposed to sunlight, the EPROM still contained all its stored bits. Call Paul for price and availability of the Z88.

Bob Swoger reported an seeing a request in SINC-LINK by George Plodke from the Chicago area for a LarKen System. Bob called George to maybe offer his spare. The conversation went something like this: "Hello, George?" "What do you want?" "I am Bob Swoger of the Chicago Timex users group" "Why are you calling at my dinner time?" "I'm sorry, shall I call back later?" "No. What do ya want?" "First, I would like to invite you to the next meeting of the Chicago Area Timex Users Group..." "Thanks BYE" CLICK! Swoger will keep his precious spare LarKen!

Meeting adjourned at 2:45 P.M.

After the meeting Bob screwed up on Steve Coopers SAFE DOS JLO system while trying to FORMAT a new disk and erased the entire JLO version of LogiCall they were both working on. SAFE DOS? ... Oh well....

Larry Sauter, Acting Secretary
Chicago Area Timex Users Group

GATOR's TWISTED PAIR

! ! ! R E M E M B E R ! ! !
We have a 24 hour BBS and encourage you to exchange mail and contribute to the Download Section. Use it and have fun!

Call the BBS at 708-632-5558 and register. On your next call your security level will be increased to 5 on this RBBS and you will be able to have most privileges.

Bob Swoger, SYSOP
Chicago Area Timex Users Group

ITEMS FOR SALE THROUGH THE CLUB

It has come to our attention that some LarKen Users are using something less than Version 3 firmware. The club will supply updated EPROMs, SYSTEM DISKS, and MANUALS for just $5 which includes shipping and handling, free if ordered with LogiCall or Spectrum ROM.

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If you are a LarKen LKDOS owner and would like a SPECTRUM V2 kit for your system we will supply an EPROM, socket and 74HCT32 for $12 which includes shipping and handling. The install instructions are in your LarKen manual. We shall not be responsible for your install job. AERCO owners need only the SPECTRUM EPROM for $10

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If you have a mismatch between you LarKen DOS EPROM and your Western Digital Controller chip, we will send you the correct one for free on behalf of our friends Rod Gowen of RMG and Larry Kenny of LarKen. You should be using L3 EPROMs with WD1770 controller chips or L3F EPROMs with WD1772 controller

chips. Check it out! Call in requests to Bob Swoger at W708-576-8068 H708-837-7957

SPECIAL DEALS AND BUYS

NAP_Ware (Nazir A. Pashtoon's new endeavor) announces the availability of all Timex or QL PAL (Programmable Array Logic) chips. If interested, call him evenings on 708-439-1679.

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LogiCall Integrated Software Ensemble easy operating system for LKDOS in both TS2068 and Spectrum modes includes LogiCall 5.0 TASWORD TWO V2.8, VU-CALC V1.6, VU-FILE and MTERM2 Drivers modified for LogiCall, DISKS.B1 TAPES.B1 steprt.B1 HEADER.BT (tape header reader by Nazir Pashtoon) FORMAT.B_ MOVE.BL and more all on 2 SSDD disks for $15. You must specify your LKDOS EPROM version. If you already have a copy you are encouraged to distribute copies to other LarKen LKDOS users for as you see by the price we are not in the business of making money on it, just making LarKen's LKDOS even better! Call in requests to Rod Gowen of RMG Enterprises.

==========

So you like to fly? The 747 Flight Simulator for Spectrum by Derek Ashton of DACC sold over 40K copies in EUROPE. Requires Spectrum Emulator. At this time supplied on LarKen SSDD disk only for $10 which goes to Derek Ashton, now working at MOTOROLA with Bob Swoger. Call in requests to Bob at W708-576-8068 H708-837-7957

ARTICLES

RELOCATING MACHINE CODE PROGRAMS IN THE TS2068

by James F. Brezina

Why would one want to relocate machine code? Many machine code programs written for the TS2068 are located in the same area of RAM. Sometimes one might want to use both if they can be used that way. If you relocate one, you may be able to use both. I had previously purchased the Zeal disassembler and found that I couldn't use my printer driver with it because they both used the same area of RAM to store their machine code. Although the printer interface I used (TASMAN) had a driver program to store in the computer's printer buffer, I found that I couldn't use that either because something in the Zeal disassembler would wipe that out. I found out that, even after transferring the printer driver to an address below the Zeal disassembler machine code, I still could not use it directly through the Zeal disassembler. I had to use the Tasman screen copy routine to get a printout of the screen. Tasman has two screen copy routines. One is for text only and is stored with the regular printer driver. The other is stored in the computer's printer buffer and will copy anything on the screen. The computer's printer buffer location is reverted to normal with NEW.

Machine code programs that have been SAVEd on tape or disk are LOADed back into the computer memory with LOAD "" CODE (or a name can be specified [must be for some disk systems]. With that simple way of ENTERing, the code is placed at the same address it was SAVEd from. If

you want to relocate it, then you enter LOAD "" CODE (address) and it will load in at the address specified. If the code contains only relative jumps and ROM calls, it can be run with no changes. If it contains absolute jumps and calls within its own addresses, these will have to be changed for the program to work. I have successfully done this to a few programs and got then to work.

A disassembler program comes in quite handy for accomplishing the changes. I use the ZEAL disassembler since it prints out the addresses in decimal. The ZEAL disassembler has a set up to PRINT to a printer, but, as far as I can tell, it only supports the TS2040 printer. The Zeal disassembler did give me an option to have the program disassembled in its present location and in its original location, or at any address I choose. If you want, you can get printouts at both locations. In order to get a printout of the Zeal disassembly, it was necessary to break out of the Zeal program with CAPS SHIFT/BREAK and then copy the screen. This was a little tough to do on the first break out, but, after that it was no trouble.

If you have made the printouts at both locations, take the two printouts and compare them. One of the things you will notice is that the relative jump addresses are different. This is correct and they do not have to be changed. You will then notice that the absolute jumps and calls are the same in both listings. You will also notice that paired registers are LOADed with numbers. These numbers are equivalent to addresses in the code. Generally, these are the HL register. All the absolute jumps will have to be changed.

If the calls and HL numbers are to ROM or (in most cases) to addresses below 26710, they do not need to be changed. If the calls and HL numbers are to addresses in the program, they will have to be changed. What I do in this case is look for the address shown in the original program. Then I find the comparable address in the relocated program and break it down into High Byte and Low Byte (i.e. High byte = INT(address/256) and Low Byte = address - High byte * 256). Once you have this information you go back to the relocated address that originally listed that address in the mnemonics and POKE the following two addresses with the low byte and high byte in that order.

It is a lot of work, but once you have everything changed, you have a relocated program that works like the original. You must re-save the changed program and it will load back in at the new address without specifying the new address. Remember that you must set RAMTOP at one address below the start of the code. Since I now have the Tasman printer driver located at 60000 and the Zeal disassembler LOADed in, I initialize the printer driver with RANDOMIZE USR 60003, and then use RANDOMIZE USR 60000 to make a text only screen copy.

I have used this procedure to move other programs. One of them was the screen copy code that Tasman had supplied. Tasman had listed a number of printers for copy codes they had on the cassette, but, they didn't list any printer (Panasonic) by name. I tried all of them, but, the only one that appeared to work correctly was one called Shin-Wa. These screen copy codes were all stored in the computer's printer buffer. There is one

thing wrong with the code being located in the computer's printer buffer. When you key NEW, the code is erased. I LOADed in the Zeal, followed by the relocated printer driver, and then the screen copy code. I got a printed copy of the disassembly of the screen copy code. I wanted to relocate to 63000, but since that was in the Zeal code area I chose 53000 to locate it at temporarily and then set the relocation to 63000 (10000 bytes) in the printout. Using the 53000 made it simpler to figure start addresses. I then made a hard copy of the disassembly and went back to the menu and changed the relocation to zero and made a hard copy of the code at 53000. Comparing all three listings, I found there I had to rake the changes.

After ENTERing the changes at 53000 to 53256, I SAVEd the code. Then, turning off the computer to clear everything out, I turned the computer on again, set RAMTOP at 62999, LOADed the copy code in at 63000. I then re-SAVEd the program at the proper address. I now have a screen copy code that remains in memory after NEW.

I think I should mention here that, one of the addresses LOADed into the HL register in the screen copy program is used to contain a number that is used to control the size of the screen copy. That address will contain a 1 for small screen copy and 0 for large screen copy. The large screen copy will not copy the full horizontal screen. It will be a few columns short on the right side. This is an example of the reason for changing the numbers held in the HL register.

Although, I do not understand enough to write my own machine code, I understand enough to figure out how to do things like relocating machine code. If you understand enough to figure that out, you can do it too.

WHY OPEN STREAM #4?

by Bob Swoger

Don Lambert wrote stating that being a less experienced programmer he could not understand why I used statements with RND, VAL and CODE in them. The answer, of course, is to save RAM space. Just a couple of bytes saved can sometimes save a whole disk track of 5090 bytes! My favorite example is opening up stream #4 to access LKDOS calls because PRINT # 4 is supposed to be easier to type [less key strokes] than RAND USR 100". [page 11 of the V3 manual] Larry Kenny suggested that it uses less RAM space in a program. The fact is it uses up MORE RAM space! (My real problem with opening stream #4 is that it is also the stream assigned to my ZEBRA Talker.)

To illustrate the RAM savings, let us consider a short program to load LogiCall. Sit down at your machine and do the following:

Turn on your TS2068 and type PRINT FREE <ENTER> . You get 38652. This is our free RAM space. Now enter the following two lines:

```
 10 RANDOMIZE USE 100: OPEN #4,
"dd"
 20 PRINT #4: LOAD "L.B1"
```

Now type PRINT FREE <ENTER>. You get 38600. Strange, 29 key-strokes used up 52 bytes!

Now EDIT the lines and put VAL with quotes around the 100 and

the two 4s. The program now reads:

```
 10 RANDOMIZE USE VAL"100": OPE
N # VAL"4", "dd"
 20 PRINT # VAL"4": LOAD "L.B1"
```

Now type PRINT FREE <ENTER>. You get 38609. Strange, you just added 9 keystrokes to the program and saved 9 bytes of RAM!

Now for the ultimate RAM saving trick. Most numbers over 31 can be expressed in the program as CODE. Let's change VAL"100" to CODE "d", the two are equivalent. (See page 242 in the TS2068 manual or type 'PRINT CODE "d" and check the response.) The program now reads:

```
 10 RANDOMIZE USE CODE"d": OPEN
# VAL"4", "dd"
 20 PRINT # VAL"4": LOAD "L.B1"
```

Now type PRINT FREE <ENTER>. You get 38611. Losing the two zeros bought us two bytes. Notice that the following statements all mean the same thing.

```
 RANDOMIZE USR 100
 RANDOMIZE USR VAL "100"
 RANDOMIZE USR CODE "d"
```

But what about OPENing stream #4 to save RAM space. Type in the program:

```
 10 LET h=CODE "d"
 20 RANDOMIZE USR h: LOAD "L.B1
"
```

Now type PRINT FREE <ENTER>. You get 38624.

Both programs will LOAD LogiCall but the busiest stream #4 call uses 41 bytes while the USR call uses only 28. Also, for the record, RAND USR h is six bytes shorter than PRINT # 4 and just as easy to type, so **WHY OPEN STREAM #4?**

PROGRAMMING TIPS

Here are a few of my favorite RAM Saving Substitutes for you to ponder:

Instead of:	Try using:
PRINT #0;	PRINT #RND;
GOTO 3	GOTO PI
PRINT #1;	PRINT #RND;
GOTO 6	GOTO PI+PI
0	NOT PI
GOTO 10	GOTO PI*PI
1	SGN PI
GOTO 8000	GOTO VAL "8e3"
100	CODE "d"
INK 3	INK INT PI
POKE 23658,0	POKE VAL"23658",NOT PI

If you are using a LarKen V2 Spectrum EPROM in your DOC port then you have a special feature not normally found in other Spectrum EPROMs. LOAD in a program with line numbered other than by 10. Also make sure that it is not using the above RAM Saving Substitutes in its GOTO or GOSUB lines. While looking at the LISTing of that program, type:

PRINT # 10

This little known command will re-number your entire program!

Reprinted from the May 1986 LIST

KEYBOARD MANIA — Part 4

By Cedric R. Bastiaans©

NOTE :
The previous installment ended with a note to the effect that I had also found a way to put the Korean SE-JIN version of the TI 99/4A keyboard in the TS 2068 case.
Please be advised, though, that the Japanese version by ALPS is STILL preferred! The black keys look better on the silver computer case but more importantly, the tactile feel is much better. But most of you, who for many years have suffered the pain of inadequate keyboards by Uncle Clive and Timex, might not note any difference and think that the SE-JIN keyboard is "heaven"!
The following is ONLY for the ALPS keyboard; I will give the modifications for the SE-JIN KB in a separate installment of KeyBoard Mania.

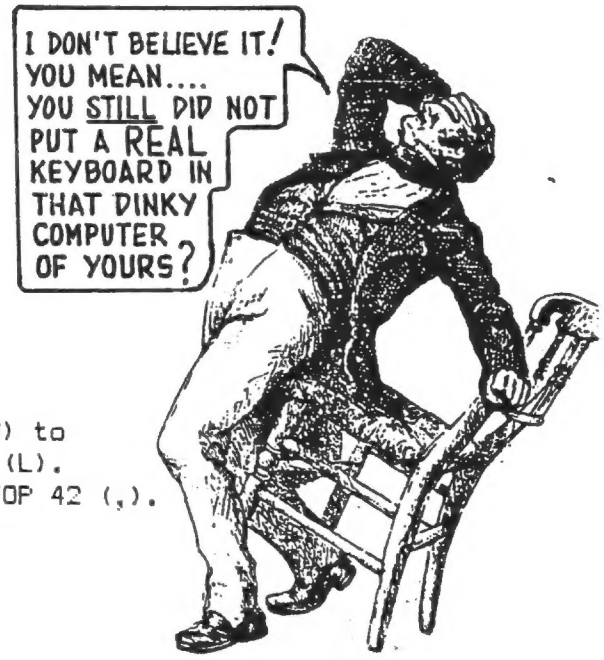
IX.5 PUTTING IN THE JUMPERS

We are now ready to put in jumpers. I suggest you use Wire Wrap hookup wire, I prefer to use 26-Gauge wire, but it is perfectly allright to use the more common 30-Gauge. This so-called Kynar wire is a joy to work with because it does not have the nasty habit of Vinyl wire creeping away on you when heat is applied.

The first thing to do, is to put a 1-pin terminal on the board. Get a STRAIGHT SINGLE-ROW MALE HEADER STRIP, typically measuring .510 inch overall. They come in rows of 36 pins and measure .100 " center to center. Radio Shack does not carry them, but most other electronic stores do.

Break off one such header pin and you have a 1-pin terminal, which you can attach with a bit of Epoxy on the PCB, in the LEFT TOP corner area between the traces SOUTH WEST of the bottom pad of Switch 10. (The remaining header pins will be used later on).
In the following, "LEFT", "TOP" and "BOTTOM" again refer to solderpads of keyswitches.

Jumper from BOTTOM 22 (/) to BOTTOM 20 (O).
Jumper from BOTTOM 25 (D) to BOTTOM 30 (K).
Jumper from BOTTOM 26 (F) to BOTTOM 29 (J).
Jumper from BOTTOM 23 (A) to BOTTOM 34 (CS).
Jumper from TOP 34 (CS) to TOP 35 (Z).
Jumper from BOTTOM 35 (Z) to BOTTOM 24 (S).
Jumper from BOTTOM 36 (X) to BOTTOM 25 (D).
Jumper from BOTTOM 37 (C) to BOTTOM 26 (F).
Jumper from BOTTOM 38 (V) to BOTTOM 27 (G).
Jumper from TOP 39 (B) to TOP 40 (N).
Jumper from BOTTOM 40 (N) to BOTTOM 29 (J).
Jumper from BOTTOM 41 (M) to BOTTOM 30 (K).
Jumper from BOTTOM 46 (CTL) to BOTTOM 48 (FCTN) to BOTTOM 31 (L).
Jumper from TOP 46 (CTL) to TOP 48 (FCTN) to TOP 42 (,).
Jumper from TOP 33 (EN) to TOP 31 (L).
Jumper from LEFT 47 (SP) to TOP 41 (M).
Jumper from TOP 11 (=) to BOTTOM 10 (O).
Jumper from 1-pin terminal to TOP 38 (V).



IX.6 ADDING THE DEDICATED KEY FUNCTIONS

We will be using either 1N914 or 1N4148 diodes to implement the functions. A word of caution: I have at least once purchased signal diodes from Radio Shack, that had their pigtails severely curtailed, 1" instead of the standard 2". You will need the full 2" length in some of the following.

Put all diodes FLAT against the PCB; I have found no need for insulation, but be careful with this. Avoid shorts!

PERIOD key, switch 43.
Connect two diodes, from BOTTOM 31 (L) and BOTTOM 41 (M), to BOTTOM 43 (banded sides towards 43).
COMMA key, switch 42.
Connect two diodes, from BOTTOM 20 (O) and BOTTOM 18 (U), to BOTTOM 42 (banded sides towards 42).
COLON key, switch 22.
Connect two diodes (unbanded sides towards TOP 22), one to the pad immediately to the right of it and the other going to the 1-pin terminal.
SEMICOLON key, switch 32.
Connect two diodes (unbanded sides towards TOP 32), one to TOP 21 (P), the other to the pad immediately NORTH NORTH WEST of 32.
DELETE key, switch 11.
Connect two diodes (unbanded sides towards BOTTOM 11), one to TOP 10 (O), the other to the 1-pin terminal.

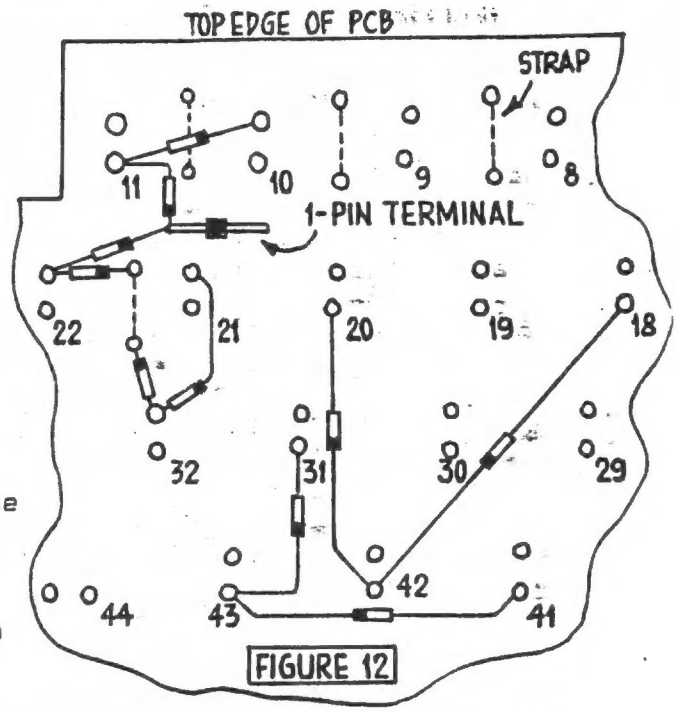


FIGURE 12

You need not be confused, because I prepared Figure 12 especially for you, to guide you along!

As I mentioned before, I leave the function for the Alpha Lock Key up to you. If you have read the preceding articles, you should have no problem implementing the necessary components for whatever function you dedicate this key to.

IX.7 CHECKING OUT THE PRINTED CIRCUIT BOARD
You may already have noticed that pins 6T and 12T on the connector are not used anymore; they have been severed during the trace cutting operation.

Now is the time to check your handiwork.
Break off a strip of 15 HEADER pins and insert this into the ribbon cable connector. Note that you have in effect, made it into a MALE connector!
Next, get yourself an OHM-meter or a continuity tester and check out the ENTIRE matrix as per the modified matrix of Figure 10 (Part 3). For instance: connect the leads of your tester to pins 8T and 11T of the connector, remembering that the pin numbering is from Right to Left, when looking at the printed circuit board, with the connector on top. Pressing either one of the two CapShift keys should produce a very low reading, close to zero ohms or a beep from the continuity tester. Check ALL the remaining keys; none should give you the same result! If there is a problem, you should carefully check the trace cuts and jumpers. Apply this procedure to all keys and their matrix coordinates. This may sound like a time-consuming affair, but it really is not and it pays off to get an early warning of anything that might have gone wrong in the preceding modifications.

Also check out the dedicated key functions, bearing in mind that the current flows from KBD to A-lines; observe the polarity of your test leads!
Correct anything that's not in order.

If you found everything to be in good order; CONGRATULATIONS! You have obviously done a good job and you're half-way into this project!

IX.8 FINISHING THE RIBBON CABLE
What's left to do is the interface with the J-9 connector of the computer board.
Remove a 14-pin section from the HEADER strip (you're done with the remainder).

Get a 5-inch length of 13-wire ribbon cable (pin 0, ground, of J-9 will not be connected), and wire this between the 14-pin and the 15-pin header strips, according to the "twistor" of Figure 13.

TI	J-9	TI	J-9	TI	J-9	TI	J-9	TI	J-9
1T	10	4T	12	7T	6	10T	7	13T	2
2T	9	5T	13	8T	1	11T	11	14T	3
3T	8	6T	N/C	9T	5	12T	N/C	15T	4

FIGURE 13

I suggest that you keep the 13-wire ribbon cable straight and neatly connected to the 14-pin header strip at the computer end, and TWIST it near the 15-pin header, which you already inserted in the 15-pin TI connector.
Also, make sure that you align the ribbon cable such that the "connector" (=14-pin header) has its #0 pin on its extreme LEFT, while you have the keyboard positioned with the keys UP and its connector (=15-pin header) towards the top.

Check your connections with your tester; make sure that you have no solder bridges between the pins! Then wrap some electrician's tape across the soldered ends of the header strips. Temporarily set the keyboard aside.

IX.9 CHECKING OUT THE KEYBOARD

Take your TS 2068 computer and turn it bottom side up. Unscrew the seven sheetmetal screws. Notice that three of these screws are longer; they are for the rearmost holes. Turn over the case and lift up the lid with its keyboard (it doesn't go all the way). Reach under the lid and carefully remove the 14-conductor ribbon cable from connector J-9. Temporarily put the lid aside.

Now, take the modified TI KB and position it immediately above the bottom part of the computer case, with its keys down, the PCB facing up, the 15-pin connector towards you. You will find that contrary to the Timex KB, your new KB has enough ribbon cable to comfortably reach the J-9 connector.
Carefully insert the 14-pin header into J-9 (remember: pin #0, on the extreme left, is NOT connected, but we provided a dummy pin for proper alignment of the header connector).

You are now ready to apply power to the computer; don't connect any peripherals, except for the monitor or TV. If everything checked out before, you should find that the new keyboard should work properly! To check this out, you can lift the keyboard on its "rear-end" allowing you to press the keys.

If you're satisfied, you should now proceed to modify the computer top. Unplug the computer; disconnect the KB and put both in a safe place.

IX.10 MODIFICATION OF THE TS 2068 CASE

Retrieve the lid and notice the overlay with all the Extended Mode legends and the indication "PERSONAL COLOR COMPUTER" on the bottom, left of the space bar. We are going to remove this. We do this by CAREFULLY prying up the left lower corner of this overlay, using a small knife with a DULL point. Work your way around; it is possible to do this without undue damage to the overlay, although as far as I'm concerned, it has done its job and should be thrown out! But remember, I'm the maniac and am therefore thoroughly biased! YOU might want to keep it.

Next we notice five Phillips screw heads. Remove these, turn over the lid and the TS 2068 keyboard will fall out. Donate it, together with the overlay, to the local Sinclair/Timex Museum Annex.
Seriously, should you ever decide to put the original TS 2068 keyboard back in place, you may rest assured that INDEED YOU CAN!

Now, remove the 2 grounding clips; we won't use them. Also, snip off the two plastic studs that stick up from the bottom of the lid.

Next comes a bit of sawing, cutting or milling. Study Figure 14; notice the 3 cutouts, depicted in black. You can make these in a variety of ways. By far the easiest is probably SAWING. Use a coping saw with .020" saw blades or use a jeweler's saw. In the latter case, however, be advised that very fine blades need COOLING! Polystyrene, the stuff of which our computer case is made, has a very low melting temperature. The heat created by sawing causes the kerf to melt together again, right behind the saw blade, causing it to bind! I therefore advise you to either use .020" blades or use water as a coolant.

You can also use a milling machine if you have access to one. Or use a Dremel Moto-Tool. Either way, just remember that Cuts # 2 and 3 should really be cutouts, whereas Cut #1 need not go all the way through the bottom (you have a choice of milling or "Dremeling" down to the bottom or cutting through). Take your time; notice the sides of the two cutouts that follow the contour of the overlay recess. These have to be cut with some degree of accuracy; the remaining sides are not so critical.
If you're going to saw, I suggest that you drill holes in each corner of a cutout, to facilitate insertion and turning of the saw blade. Remove burrs with a file.

Next, you have to file and maybe countersink the area in the lower right corner; this is to clear some of the protrusions of the PCB connections of Switch 48.

Take your modified TI keyboard, slip the ribbon cable through Cutout #2 and ease it into the modified keyboard recess. You do this by inserting the right-hand portion into cutout #3 first and then dropping the left-hand portion into the recess, moving the keyboard as far to the right as possible. It should sit flush with its PCB right on top of the computer case. Neat, huh?

Take a marker and mark the top hole in the left-hand mounting flange. Drill a #6 hole in the bottom of the lid, use #6 hardware but invert the #6 screw, so that the nut is inside the lid. If you're satisfied with the alignment, put a little Epoxy around the nut onto the metal flange (NOT on the threads!) and you will not have to worry about ever losing the nut inside the lid.

Finally, fold a small piece of stiff cardboard or fish paper and wedge it between the right-hand mounting flange of the TI KB and the TS 2068 case. The KB is firmly held.

Next installment will disclose a neat way of making keytops for the TS 2068.